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MATHEMATICAL PHYSICS.—*The quantum theory of Born and Wiener.* R. J. SEEGER, The George Washington University.[1]
(Communicated by EDGAR W. WOOLARD.)

The quantum theory of Born and Wiener[2] was devised as an operational calculus to confine the infinite matrices of Heisenberg to a region of mathematics more highly developed analytically. Another merit was the utility of its structure for aperiodic, as well as periodic, motions. Despite both these advances, however, it soon succumbed to the simpler method of Schrödinger, which still holds sway. Indeed, Schrödinger's equation is now the epitome of quantum mechanics. But the more the success of the latter's applications is unquestionable, the more problematic is the interpretation of its usefulness. This has become the crux of the new theory so that much discussion of fundamental concepts has enlarged physics into metaphysics. At present, there are two schools of thought—not to mention pessimistic outlooks—: the one accepts the equation as an accidental revelation to be given a special, physical meaning; the other looks upon it as an incidental emergence to be evolved from a general, mathematical technique. This second view is precisely the one previously considered by Born and Wiener in a different application; hence, the desirability of extended work in this direction.

In particular, their theory attempts to fix operations which will yield the elements of the respective, associated matrices (if these exist) upon application to a given exponential function. The physical postulate, that the latter be real representations, necessitates matrices of the Hermitian type. The method is to subject the operational equations of motion to the quantum condition. It has been used so far to solve two problems: the linear, harmonic oscillator and the free

[1] Received June 23, 1931.

[2] Born, M. and Wiener, N. Zs. f. Phys. 36: 174.

particle in one dimension. The following solution of a particle in a a uniform field is of additional value from a critical standpoint.

Consider a particle moving along the axis of a constant force F. If m be the mass (nonrelativistic case), then the Hamiltonian expression for the total energy H is

$$H \equiv \frac{1}{2m} P^2 + FQ^2$$

where Q is the positional coordinate and P its corresponding momentum. Hence, the equation of motion is

$$\ddot{Q} = -\frac{F}{m}$$

Let $$Q \equiv t^2 \Phi_1 (D) + t \Phi_2 (D) + \Phi_3 (D)$$

where t signifies the time and D the first derivative with respect to it. Using the definition

$$\dot{Q} \equiv DQ - QD$$

we have $$\ddot{Q} = 2 \Phi_1 (D)$$

$$\therefore \quad \Phi_1 (D) = -\frac{F}{2m}$$

and $$Q \equiv -\frac{F}{2m} t^2 + t \Phi_2 (D) + \Phi_3 (D)$$

The quantum condition is

$$PQ - QP = \frac{h}{2\pi i} \qquad i \equiv \sqrt{-1}$$

Or, since $$P = m \dot{Q},$$

$$\therefore \quad \dot{Q}Q - Q\dot{Q} = \frac{h}{2\pi i m}$$

i.e. $$\left\{-\frac{F}{m} t + \Phi_2 (D)\right\}\left\{-\frac{F}{2m} t^2 + t \Phi_2 (D) + \Phi_3 (D)\right\}$$

$$-\left\{-\frac{F}{2m} t^2 + t \Phi_2 (D) + \Phi_3 (D)\right\}\left\{-\frac{F}{m} t + \Phi_2 (D)\right\} = \frac{h}{2\pi i m}$$

Using Leibnitz' formula, namely,

$$\Phi\,(\mathrm{D})\;t \equiv t\,\Phi\,(\mathrm{D}) + \Phi'\,(\mathrm{D}) \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

we obtain

$$-\frac{\mathrm{F}}{2\,m}\,\Phi''\,(\mathrm{D}) + \frac{\mathrm{F}}{m}\,\Phi_3'\,(\mathrm{D}) + \Phi_2'\,(\mathrm{D})\,\Phi_2\,(\mathrm{D}) = \frac{h}{2\,\pi\,i\,m}$$

Let this operate on $e^{\frac{2\pi i}{h}\mathrm{W}t}$, where W represents the value of the energy in the particular state concerned.

Put $$w \equiv \frac{2\,\pi\,i}{h}\,\mathrm{W}$$

$$\therefore \quad -\Phi_2''\,(w) + 2\,\Phi_3'\,(w) + \frac{2\,m}{\mathrm{F}}\,\Phi_2'\,(w)\,\Phi_2\,(w) = \frac{h}{\pi\,i\,\mathrm{F}}$$

$$\therefore \quad \Phi_2'\,(w) - 2\,\Phi_3\,(w) - \frac{m}{\mathrm{F}}\,\{\Phi_2\,(w)\}^2 = -\frac{h\,w}{\pi\,i\,\mathrm{F}} + \mathrm{A}_\phi \ldots\ldots (2)$$

where A_ϕ is the constant of integration.

Put $$\frac{\Psi_2'\,(w)}{\Psi_2\,(w)} \equiv -\frac{\mathrm{F}}{m}\,\Phi_2\,(w)$$

$$\therefore \quad \Psi''\,(w) - \left\{-\frac{2\,m}{\mathrm{F}}\,\Phi_3\,(w) + \frac{h\,w}{\pi\,i\,m\,\mathrm{F}^2} + \mathrm{A}_\psi\right\}\Psi_2\,(w) = 0 \ldots (2\mathrm{A})$$

We note that (2A) is the specialized Riccatti equation, which has previously appeared in the new quantum mechanics in various forms as "Schrödinger's equation."

Let us now introduce the Hermitian condition, i.e.

$$\tilde{\mathrm{Q}} = \mathrm{Q}^*$$

where the wavy line indicates the operator which will yield the transpose-matrix of that given by Q, and the asterisk signifies the one which will give the complex-conjugate. In this case it becomes

$$-\frac{\mathrm{F}}{2\,m}\,t^2 + t\,\Phi_2\,(\mathrm{D}) + \Phi_3\,(\mathrm{D}) = -\frac{\mathrm{F}}{2\,m}\,t^2 + \Phi_2^*\,(\mathrm{D})\,\{-t\} + \Phi_3^*\,(\mathrm{D})$$

Operating this on $e^{\frac{2\pi i}{h} W t}$, we have

$$t\,\Phi_2(w) + \Phi_3(w) = -\Phi_2^*(w)\,t + \Phi_3^*(w)$$

Again using relation (1), we obtain

$$\Phi_2(w) = -\Phi_2^*(w) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3a)$$

and

$$\Phi_3(w) = -\Phi_2'^*(w) + \Phi_3^*(w) \quad \ldots\ldots\ldots\ldots\ldots (3b)$$

From (3a) we learn that $\Phi_2(w)$ is purely imaginary; from (3b), that the imaginary part of $\Phi_3(w)$ is equal to $-\frac{1}{2}\Phi_2'^*(w)$. Therefore, put

$$\Phi_3(w) = \Phi(w) - \tfrac{1}{2}\Phi_2'^*(w)$$

where $\Phi(w)$ is real. Substituting this in (2), we have

$$-\frac{m}{F}\{\Phi_2(w)\}^2 = -\frac{h\,w}{\pi\,i\,F} + 2\,\Phi(w) + A_\Phi \ldots\ldots (2B)$$

Put

$$\phi(w) \equiv -\frac{F}{m}\{2\,\Phi(w) + A_\Phi\}$$

$$\therefore \quad \Phi_2(w) = \left\{\frac{h\,w}{\pi\,i\,m} + \phi(w)\right\}^{\frac{1}{2}}$$

and $$\Phi_3(w) = \Phi(w) - \tfrac{1}{2}\left\{\frac{h}{2\,\pi\,i\,m} + \tfrac{1}{2}\phi'(w)\right\}\left\{\frac{h\,w}{\pi\,i\,m} + \phi(w)\right\}^{-\frac{1}{2}}$$

$$\therefore \quad Q \equiv -\frac{F}{2\,m}t^2 + t\left\{\frac{h\,D}{\pi\,i\,m} + \phi(D)\right\}^{\frac{1}{2}}$$

$$+ \Phi(D) - \tfrac{1}{4}\left\{\frac{h}{\pi\,i\,m} + \phi'(D)\right\}\left\{\frac{h\,D}{\pi\,i\,m} + \phi(D)\right\}^{\frac{1}{2}} \ldots\ldots (4)$$

If F = 0, we have the case of a free particle. Then

$$Q_0 = t\left\{\frac{h\,D}{\pi\,i\,m}\right\}^{\frac{1}{2}} + \Phi(D) - \tfrac{1}{4}\left\{\frac{h}{\pi\,i\,m\,D}\right\}^{\frac{1}{2}} \ldots\ldots\ldots (4A)$$

Equation (4a) agrees with that obtained by Born and Wiener. It is to be noted that their transpose-operator is published incorrectly Another mistake in sign later happens to make matters right again.

We form the "Spaltensumme" thus:

$$Q(t, W) = e^{-\frac{2\pi i}{h} W t} Q e^{\frac{2\pi i}{h} W t}.$$

$$\therefore Q(t, W) = -\frac{F}{2m} t^2 + \left\{\frac{2W}{m} + \phi\left(\frac{2\pi i}{h} W\right)\right\}^{\frac{1}{2}} t + \Phi\left(\frac{2\pi i}{h} W\right)$$

$$- \tfrac{1}{4} \left\{\frac{h}{\pi i m} + \phi'\left(\frac{2\pi i}{h} W\right)\right\} \left\{\frac{2W}{m} + \phi\left(\frac{2\pi i}{h} W\right)\right\}^{-\frac{1}{2}}$$

and $$P(t, W) = -Ft + \left\{\frac{2W}{m} + \phi\left(\frac{2\pi i}{h} W\right)\right\}^{\frac{1}{2}}$$

This agrees with the classical formula only for W large and for $\phi = 0$. Hence, there is an arbitrariness in the general solution. This lack of uniqueness and the relation to the Schrödinger type of equation are the distinctive features of this problem.

There is one point more, however, which is important. Born and Wiener deduce the Hermitian condition subject to the vanishing of the time-function $w(t)$ as t becomes infinite. For then the following integral has a finite value in the limit:

$$U(\alpha) \equiv \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{+T} e^{i\alpha t} u(t)\, dt$$

In the problem of a free particle $U(\alpha)$ does not exist; for the integral becomes oscillatory as $T \to \infty$. In the case of a particle in a uniform field $U(\alpha)$ becomes infinite. And the former is again true for the linear harmonic oscillator. The question arises as to the validity of the proof for these applications. Perhaps it is advisable to look upon this particular operational form of the Hermitian condition as a generalized definition, a hypothesis to be justified pragmatically.

ENTOMOLOGY.—*Synopsis of* Perigaster *(Coleoptera: Curculionidae).*[1]

L. L. BUCHANAN, Bureau of Entomology. (Communicated by HAROLD MORRISON.)

Some time ago, Mr. W. J. Brown of Ottawa, Ontario sent the writer an undescribed species of the ceutorhynchid genus *Perigaster*. The attempt to fit this species in the existing classification brought to light several unrecorded structural peculiarities that modify the generic and specific definitions heretofore followed.

In the first place, the scrobe, which has been described as linear, oblique, and directed beneath eye, is in reality no more than a terminal oval pit for receiving the globular base of scape. From this pit there extends directly toward the eye a variably distinct sulcus which, however, does not conceal or protect the scape in its position of rest. The sulcus is often partially, and sometimes entirely, obliterated, and is always more or less punctate and scaly, in these respects contrasting strongly with the normally formed scrobe, which is deep, glabrous, and without evident sculpture except for a shagreened or alutaceous surface. In some specimens of *Perigaster* this "false" scrobe is rather deep, but its vestigial nature is shown by indefinite margins, by the presence of punctures or scales, or by other indications. As the scrobe proper is virtually effaced, its direction can not be used as a generic character.

The published requirement for simple claws is only partly correct, the claws being simple in *obscura*, minutely toothed in *cretura* and *longirostris*, and strongly toothed in *tetracantha*.

The antennal funicle can be regarded as six-segmented, although in *tetracantha* especially, and in rare individuals of the other species, there is a fairly well differentiated seventh segment at the base of the club. In the great majority of specimens the funicle appears to be truly six-segmented.

The narrow shelf-like production of the second abdominal segment (see figure 1), forming the surface over which the third segment slides when tip of abdomen is depressed, has definite taxonomic value. This structure is called simply "shelf" in key and descriptions. When the abdomen is depressed, the visible surface of the third segment becomes equally broad from side to side; this fact should be kept in mind in interpreting the published statement, "third segment narrowed at sides."

As treated here, *Perigaster* shows the following generic characters:

[1] Received May 27, 1931.

Rostrum wider and thicker toward apex; scrobes vestigial except at tip; scape inserted at about apical one-third, the funicle six-segmented; posterior eye margin acutely elevated; prothorax with the four usual cusps well developed, and in addition generally with a minute one on anterior margin a short distance below apical cusp (see figure 1), ocular lobes feeble or absent; base of prothorax and elytra thickened and raised; fore coxae separated by one-third to two-thirds the width of a coxa, antecoxal ridges absent, prosternal emargination deep, U-shaped; femora mutic, third tarsal segment bilobed, claws simple or toothed; third ventral narrowed at sides with abdomen in normal position; male with mid and hind tibiae mucronate.

These characters apply more strictly to the northern species; as is brought out in the key, *tetracantha* Champion from Panama differs in several important respects and properly forms a distinct subgenus.

To avoid repetition, a few general characters common to the three or four North American species are briefly outlined here and are not mentioned again in the descriptions.

Head: Occiput with a distinct longitudinal carina; eyes one-half to two-thirds covered in repose; scape short, failing to reach eye by about length of first funicular segment; funicle with first three segments elongated, the first much stouter. *Prothorax* subconical in shape, the sides nearly straight to moderately arcuate, hardly constricted at apex. *Elytra* with tenth interval somewhat depressed at basal third, causing a sinuation of outline as seen from above, striae 2 to 6 inclusive, especially the latter, terminating at base in a pit, femora broadly and indefinitely annulated with scales at apical third. The standard markings above consist of a band of pale scales across base of head, a stripe along each side of pronotum, wider in front, and white spots on elytra as follows: One on third interval at basal third, one on seventh interval at or a little before middle, and occasionally a smaller one at apical termination of third interval, one or more of these spots commonly missing.

The remarkable dung-bearing habits of the externally feeding larvae are described by Knab (Proc. Ent. Soc. Wash., vol. 17, 1915, p. 194). Knab's specimens, or part of them, now preserved in the National collection, prove to be *cretura* instead of *obscura* as published.

KEY TO SPECIES OF PERIGASTER

1. Scape very short, less than one-third length of funicle with club (ratio about 6 to 22), attached a little before middle of beak, scrobe merely an oval pit; rostrum short, scarcely longer than depth of head, in side view a little thicker at base than toward apex; distance between fore coxal almost equal to length of scape; pronotum more strongly arched longitudinally; dorsum with dense covering of minute, suberect, dark brown to black scales, with some white scales forming a stripe each side of pronotum and a very faint transverse median band on elytra reaching from margin inward about half way to suture, a few scattered white scales on apical half of elytra, on humeri, and at base of pronotum; under surface with small close-set white scales; tooth of tarsal claws long, one-half to

two-thirds length of claw; body form very stout, the elytra a little broader than long. Length, 2.45 mm.; width, 1.65 mm. Panama. **tetracantha** Champion.

Scape distinctly more than one-third length of funicle with club (ratio about 8 to 20), attached about one-third from apex; rostrum thicker toward apex; scape much longer than distance between fore coxae; scales on dorsum much larger, prostrate; tooth of tarsal claw minute or absent; form generally less stout. Species north of Mexico.....2

2. Tarsal claws simple; shelf of second ventral segment not punctate and not rugose; profile of rostrum and head more abruptly discontinuous; rostrum stout, generally much less than twice as long as broad; pronotum generally uneven, due to a conspicuous median swelling; anterior coxae separated by about two-thirds their width; elytral intervals 3, 5, and 7 frequently elevated in basal half. Southeastern United States. **obscura** Leconte.

Claws with a minute basal tooth; shelf of second ventral generally sculptured to some extent; profile of head and beak less abruptly discontinuous; median pronotal swelling feeble or absent.....3

3. Rostrum short and stout, almost always distinctly less than twice as long as broad; shelf of second ventral smooth or lightly punctate across a narrow basal strip; entire dorsum rather even, the pronotal swelling feeble or absent and alternate elytral intervals less elevated; anterior coxae separated by one-half to two-thirds their width; body stouter. Eastern United States.....**cretura** Herbst.

Rostrum longer and more slender, a little more than twice as long as broad; shelf of second ventral coarsely sculptured; ground color darker, the dorsum often marmorated; third, fifth, and seventh elytral intervals more distinctly elevated; fore coxae separated by about one-third their width. Canada, south to New Jersey and west to Washington...**longirostris** n. sp.

* * * *

Rostrum scarcely as long as head, with an obtuse median carina; punctures of occiput in striae; elytra with alternate intervals wider and higher. Royal Palm Park, Florida, 1 female.....**alternans** Blatchley. (Species not seen; possibly a well developed form of *obscura*).

PERIGASTER CRETURA Herbst. (QUADRISPINOSA Say)

Length, 2.5–3.2 mm.; width, 1.6–2.15 mm. Robust, dorsum generally even, scales of two sizes, the larger pale ones sparse or wanting on disk of pronotum, on humeral swelling, and on various small scattered areas on elytra, being replaced to some extent on these places by much smaller, narrower, coppery scales.

Rostrum feebly arcuate, above finely and closely punctate and frequently with a narrow median line either smooth or very finely grooved, scales small and sparse above but larger on sides near apex, a band of dirty white oval scales between eyes; head with a large median flattened or concave area opposite posterior eye margin, the occipital carina often extending down to the concavity. Pronotum finely and densely punctate, commonly with an indefinite medially interrupted line of dirty white scales, surface abruptly declivous at middle of base. Elytral intervals flat to feebly convex, more convex toward sides, third, fifth, and seventh slightly broader and higher in many specimens, surface of intervals finely but irregularly sculptured or granulose, the granules on fifth, seventh, and ninth sometimes developed into minute denticles, more evidently so near apex; striae deep, with small close-

set punctures, each puncture partially closed by an oval or narrowly oblong longitudinally directed scale. Venter with close-set circular scales.

Oklahoma; Texas; Louisiana; Alabama; Florida; North Carolina; Virginia; Maryland; New Jersey; New York; Massachusetts; Michigan; Illinois. 150 specimens.

This species presents a characteristic habitus due to the very stout body form and the comparatively smooth dorsum. The relatively even distribution of vestiture gives the upper surface a smooth gray appearance, contrasting with the unevenly marked or marmorate dorsum in *longirostris* and *obscura*. *P. cretura* differs from these two also in having the scales on dorsum narrower, and the antennae inserted a little nearer to apex of beak. The apical prothoracic cusps are often feeble.

PERIGASTER OBSCURA Leconte (QUADRISPINOSA Gyll.).

Length, 2.4–3.1 mm.; width, 1.55–2.1 mm. Slightly less robust than *cretura*, the ground color darker, the larger pale scales sparser, the smaller brassy ones rather more conspicuous, the dorsum more uneven.

Rostrum moderately to rather strongly arched, finely punctate above, more coarsely at sides; head densely, more or less rugosely punctate, the area between and behind eyes flattened or concave, and often with brassy scales; pronotum typically with well developed median hump, the punctures either uniformly fine and dense, or coarser and finer intermixed, a feeble median longitudinal groove often evident; elytra with intervals convex, the third, fifth, and seventh generally somewhat elevated; striae rather deep, the strial punctures a little larger and sparser than in *cretura* or *longirostris*. The vestiture and punctation on venter, except on pro- and mesosterna, is generally sparser than in *cretura*.

Louisiana; Mississippi; Alabama; Florida; Virginia; Maryland; District of Columbia.

In typical examples from Florida, this species differs from the others in the shorter, stouter, more strongly arcuate beak, the sparser vestiture above and below, the sparser and more irregular pronotal punctures, the presence of a faint median pronotal sulcus, the feebler granulations on elytral intervals, etc. These differences break down, one by one, in the more northern specimens, leaving only the alutaceous shelf of second ventral and the absolutely simple tarsal claws as certain definitive characters. Only about two dozen specimens of this species have been seen; perhaps a greater number would contain exceptions to any single structural character.

The name *quadrispinosus* Gyll. 1836, a homonym of *quadrispinosus* Say 1824, was listed in the synonymy of *cretura* Hbst. by Leconte 1885 and by Dietz 1896. Gyllenhal's description, based on a Mississippi specimen, fits *obscura* Lec. better than *cretura* Hbst., so *quadrispinosus* Gyll. may be considered a synonym of Leconte's species.

Perigaster longirostris, new species.

Figure 1.

Length, 2.2–2.6 mm.; width, 1.35–1.75 mm. (19 specimens, male and female).

Rather stout, black or dark piceous, pronotum with a broad, indefinite, medially interrupted stripe of rounded scales, elytra with scattered brown to

white rounded scales interspersed with minute narrow brassy scales giving the surface a marmorated appearance, the rounded scales more or less condensed along the suture, and sometimes also in a short transverse bar at basal third, thus forming a cross or inverted T, depending on length of sutural stripe, these marks not sharply defined. Legs reddish.

Rostrum moderately arcuate, a little more than twice as long as broad, finely and closely punctate, more sparsely toward apex, the punctures showing a tendency toward linear arrangement on upper surface behind antennal insertion, and often leaving a fairly distinct median line smooth; surface glabrous above, more or less scaly at sides. Scrobe an elongate pit one-third from apex of beak, false scrobe punctate and scaly, extending back to or almost to eye. Head densely, finely punctate, flattened or slightly concave between and behind eyes, with a band of oval scales between eyes. Pronotum densely punctate, moderately arched, abruptly declivous at middle of base; ocular

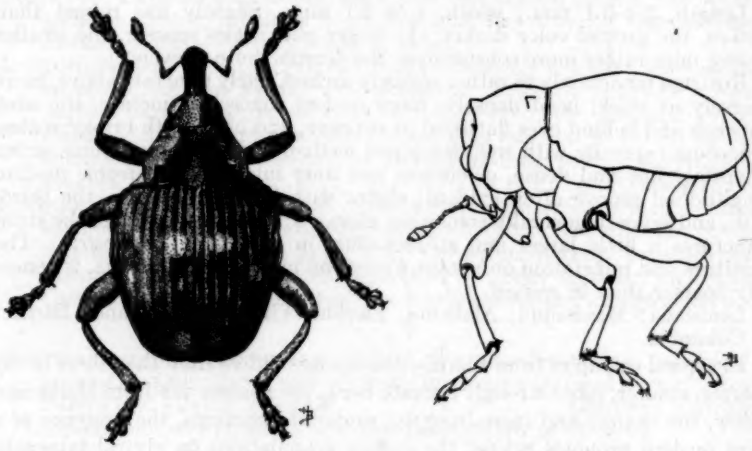

Figure 1. *Perigaster longirostris*, new species, × 18. (Drawn by HARRY BRADFORD)

lobes more or less evident. Elytral striae rather broad and deep, strial punctures close-set, intervals convex, finely granulose, the granules on fifth, seventh, and especially on the ninth developed into minute denticles from each of which projects posteriorly a scalelike hair, the third, fifth, and seventh intervals as a rule broader and slightly elevated; humeri prominent and subglabrous; tenth interval depressed at basal one-third causing a sinuosity in outline of elytra from dorsal point of view. Venter with rounded pale scales, contiguous to overlapping over most of the surface, except on last four ventral segments and on lower part of propleura where they are sparser. Femora reddish, often with darker blotches near base and apex, indefinitely and broadly annulated with scales at apical third.

Type locality: Ottawa, Ontario (Harrington). 14 specimens, type and 13 paratypes.

Other localities (Paratypes): Mt. St. Hilarie, Quebec, 1 specimen; Detroit, Michigan (Hubbard and Schwarz), 1 specimen; Irvington, New Jersey

(Bischoff Collection), 1 specimen; Iowa (Wickham), 1 specimen; Pullman, Washington (J. F. Clarke), 1 specimen.

Type: A male, in Canadian National Collection.

Paratypes: 9 in Canadian National Collection; 9 in U. S. National Museum Collection, Cat. No. 43532.

The elytral vestiture varies considerably, showing a tendency toward the development of a transverse band beginning on suture at basal third and extending laterally either at right angles or obliquely backward to connect with spot on seventh interval. An irregular marmoration of the surface is conspicuous in well preserved specimens. The ocular lobe, a noteworthy character in this genus, varies from a feeble to a fairly well defined form, though never strongly developed; the lobe covers about three-fourths of the eye with rostrum in position of rest.

Properly mounted specimens of this species should be recognizable by the longer beak, narrowly separated fore coxae, presence of feeble ocular lobes, rugosely sculptured shelf of second ventral segment, better development of denticles on ninth interval of elytra, and the exceedingly minute tooth on tarsal claws. The last named character is difficult to see with less than about 40 magnifications. The upper eye margin is not so much elevated above head surface as in *cretura* and *obscura*. When the three species are compared in series, *longirostris* is seen to be distinctly the smallest.

BOTANY.—*Nine new American Asteraceae.*[1] S. F. BLAKE, Bureau of Plant Industry.

This paper contains descriptions of nine new species of Asteraceae, of which one is from Utah, two are from Mexico and Central America, and six are from South America. Several transfers of names and new names and two new varieties are also included.

Vernonia calderoni Blake, sp. nov.

Sect. *Eremoseos;* frutex; rami tomentosi glabrescentes; folia oblongo-ovata v. elliptica majuscula supra mox glabrata subtus laxe griseo-tomentosa; capitula parva 5-flora in axillis glomerata; involucrum dense tomentosum; achenia 5–6-costata dense breviterque pilosa.

Shrub 3 m. high; branches somewhat zigzag; leaves alternate; petioles thick, gray-tomentose, about 4 mm. long; blades 7–12 cm. long, 3–5 cm. wide, obtuse or acutish, apiculate, at base cuneate, remotely and obscurely callous-denticulate, papery, above dotted with sessile shining glands, glabrate except along costa, beneath thinly and somewhat floccosely but persistently tomentose and gland-dotted, featherveined, the lateral veins 8–10 pairs, prominulous beneath, the veinlets reticulate beneath; heads short-pedicelled or subsessile, crowded in axillary glomerules 1.5-2 cm. thick, these confluent at tips of stem and the short branchlets; involucre about 5 mm. high, strongly graduate, about 7-seriate, the phyllaries broadly triangular-ovate to lance-oblong and

[1] Received May 28, 1931.

(innermost) nearly linear, densely tomentose and somewhat gland-dotted, obtuse, the innermost acutish, deciduous; corollas about 4.5 mm. long; achenes 3 mm. long; pappus whitish, the outer of linear squamellae about 1.5 mm. long, the inner of aristiform barbellate bristles 4.5 mm. long.

SALVADOR: Sierra de Osicala, Dept. Morazán, April 1929, *Salvador Calderón* (type No. 1,406,895, U. S. Nat. Herb.; dupl. in herb. Field Mus.).

A species combining the inflorescence and achenes of *Vernonia standleyi* Blake with the leaves of *V. leiocarpa* DC.

Lepidophyllum phylicaeforme var. **resinosum** (Walp.) Blake.

Vernonia phylicaeformis var. *resinosa* Walp., Nov. Act. Acad. Caes. Leop.-Carol. **19**: Suppl. **1**: 253. 1843.

Baccharis lucida Meyen, Walp. Nov. Act. Acad. Caes. Leop.-Carol. **19**: Suppl. **1**: 253. 1843, as synonym.

Possibly a distinct species, but differing from typical *Lepidophyllum phylicaeforme* (Meyen) Hieron. only, so far as known, in its glabrous and resinous (not tomentose) stem and branches. *R. E. Fries* 675, from Argentina, distributed as *L. phylicaeforme*, represents this variety. I have elsewhere[2] discussed the identity of *Lepidophyllum phylicaeforme* and *Parastrephia ericoides* Nutt.

Solidago auriculata Shuttleworth, nom. nov.

Solidago amplexicaulis Torr. & Gray, Fl. N. Amer. **2**: 218. 1842. Not *S. amplexicaulis* Martens, Bull. Acad. Brux. **8**: 67. 1841.

Solidago auriculata Shuttl., A. Gray, Syn. Fl. N. Amer. **1**[2]: 153. 1884, as synonym.

Aster amplexicaulis Kuntze, Rev. Gen. Pl. **1**: 317. 1891. Not *A. amplexicaulis* Lam. 1783, or Michx. 1803, or Muhl. 1803.

Torrey and Gray, when describing this species, did so under the name "*S. amplexicaulis* (Martens?)," stating that they attributed the name to the plant described merely on the basis of its appropriateness, not having seen the original publication of Martens. Chapman[3] in 1860 used the same name, with the authority Torrey & Gray, and Gray in his later writings continued to do so, after it had been ascertained that Martens' name referred to *S. riddellii* Frank. The appropriate name *S. auriculata*, under which the species was distributed by Shuttleworth (according to Gray), is here given proper publication.

Solidago graminea (Woot. & Standl.) Blake.

Petradoria graminea Woot. & Standl., Contr. U. S. Nat. Herb. **16**: 183. 1913.

A species closely related to *Solidago petradoria* Blake (*S. pumila* (Nutt.) Torr. & Gray, not Crantz; *Petradoria pumila* Greene), but with very much

[2] Contr. U. S. Nat. Herb. **26**: 232. 1930.
[3] Fl. So. U. S. ed. 1. 213. 1860.

narrower leaves. Originally described from northwestern New Mexico, it has also been found in the Kaibab National Forest in northern Arizona (specimens collected 13 Aug. 1926, received through Dr. C. D. Marsh; in U. S. Nat. Herb.) and about 7½ miles south of Scipio, Millard County, Utah, alt. 1650 meters, 20 June 1930 (*G. D. Pickford* 28; herb. U. S. Forest Service).

Aster pantotrichus Blake, nom. nov.

Aster missouriensis Britton in Britton & Brown, Ill. Fl. 3: 378. *f.* 3794. 1898. Not *A. missuriensis* (sic) Kuntze, Rev. Gen. Pl. 1: 318. 1891. (Based on *Solidago missouriensis* Nutt.)

Aster pantotrichus var. **thyrsoideus** (A. Gray) Blake.

Aster diffusus var. *thysoideus* A. Gray, Syn. Fl. N. Amer. 1[2]: 187. 1884.
Aster lateriflorus var. *thyrsoideus* Sheldon, Bull. Torrey Club 20: 286. 1893.

As the name *Aster missouriensis* Britton must be abandoned owing to the previous use of the same name by Kuntze, and as Gray's varietal name *thyrsoideus* is ineligible for raising to specific rank because of *Aster thyrsodeus* (E. Meyer) Kuntze,[4] it is necessary to provide the species with a new name.

Erigeron phoenicodontus Blake, s p.nov.

Perennis caespitosus ubique dense cinereo-strigosus, involucris dense breviterque hirsutis exceptis; folia basalia anguste oblanceolata acuta integra 1-nervia, petiolis base ampliatis albidis ciliatis, caulina parva linearia; caules simplices monocephali, capitulis mediocribus breviter pedunculatis; involucri paullum gradati phyllaria linearia, intima apice scariosa purpurea; radii ca. 40 albi parvi; achenia basi excepta glabra 10-nervia subteretia; pappus biseriatus, exteriore breviter setuloso.

Stems and leaves densely cinereous-strigose throughout, in small tufts from a few-branched, apparently deep and vertical cylindric root; fibrous bases of basal leaves persistent; stems 1–6 in a tuft, erect, simple, 1-headed, about 15 cm. high; basal leaves narrowly oblanceolate, 2.5–3.8 cm. long including the petioliform base, 2–3 mm. wide, acute, acuminate at base, entire, firm, 1-nerved, the base of the petiole somewhat enlarged, whitish, subscarious, ciliate, 3-nerved; stem leaves about 15, gradually reduced above, linear, the upper bracteiform and 3–6 mm. long; peduncles 1–15 mm. long; heads about 1.8 cm. wide; disk 1.3–1.5 cm. thick; involucre hemispheric, 4–5-seriate, slightly graduate, 5 mm. high, the phyllaries linear, acute to short-acuminate, densely hirsute with straight, mostly ascending hairs, the inmost phyllaries with green midline, whitish chartaceous margin, and scarious purple tips, the others with green midline and whitish margins; rays about 35–40, white, the tube sparsely pilose at apex with many-celled hairs, 2.5 mm. long, the lamina linear, tridenticulate, 4-nerved, 5 mm. long, 1.2 mm. wide; disk flowers very numerous, their corollas purplish above, sparsely pilosulous near middle, 4.5–5 mm. long (tube 1–1.5 mm., throat cylindric-funnelform, 3 mm., teeth 5, deltoid, papillose-crested, 0.5 mm. long); achenes of ray and disk similar, subterete, yellowish white, 9–10-nerved, glabrous except for a few bristles at extreme base, 2.3 mm. long; pappus of an outer series of minute setae about 0.3 mm. long and an inner series of about 35

[4] Rev. Gen. Pl. 1: 317. 1891. (Based on *Solidago thyrsoidea* E. Meyer.)

whitish barbellate bristles 4 mm. long; style appendages depressed-deltoid, obtuse, finely hispidulous.

MEXICO: Sides of steep dry ravines, in red gravelly soil, Rancho Colorado, District of Guerrero, State of Chihuahua, alt. 2200 m., 27 May 1929, *Ynes Mexia* 2569 (type no. 1,409,875, U. S. Nat. Herb.).

A well-marked species, perhaps nearest *Erigeron ervendbergii* A. Gray, but with a different habit, much denser pubescence, and decidedly larger heads.

Archibaccharis serratifolia var. **paniculata** (J. D. Sm.) Blake.

Diplostephium paniculatum J. D. Sm., Bot. Gaz. **23**: 8. 1897.

Hemibaccharis mucronata paniculata Blake, Contr. U. S. Nat. Herb. **20**: 551. 1924.

Archibaccharis mucronata paniculata Blake in Standl., Contr. U. S. Nat. Herb. **23**: 1509. 1926.

Archibaccharis mucronata var. *paniculata* Blake, Amer. Journ. Bot. **15**: 64. 1928.

I have recently shown,[5] that the name to be adopted for the species long known as *Baccharis mucronata* H. B. K. is *Archibaccharis serratifolia* (H.B.K.) Blake.

Pluchea salicifolia var. **canescens** (A. Gray) Blake.

Pluchea subdecurrens var. *canescens* A. Gray, Proc. Amer. Acad. **5**: 182. 1861.

Pluchea adnata canescens Blake in Standl., Contr. U. S. Nat. Herb. **23**: 1510. 1926.

Pluchea salicifolia var. **parvifolia** (A. Gray) Blake.

Pluchea subdecurrens var. *parvifolia* A. Gray, Proc. Amer. Acad. **5**: 160. 1861.

Pluchea adnata parvifolia Blake in Standl., Contr. U. S. Nat. Herb. **23**: 1510. 1926.

I have recently shown[6] that the name *Pluchea salicifolia* (Mill.) Blake, based on *Conyza salicifolia* Mill., must be used in place of *P. subdecurrens* Cass. and *P. adnata* (Humb. & Bonpl.) Mohr.

Gnaphalium paramorum Blake, sp. nov.

Herba perennis caespitosa parva ubique dense et compacte sericeo tomentosa haud stolonifera; folia basalia rosulata subspathulata obtusa 1-nervia 1.5 cm. longa 5 mm. lata, caulina ca. 6–8 similia minora; capitula ca. 48-flora numerosa sessilia in glomerulum terminalem 1.5–2.5 cm. crassum aggregata; involucri ca. 5 mm. alti gradati phyllaria linearia apice rotundata v. obtusa basi castanea apice subaequali lactea opaca; flores fem. ca. 39, hermaph. ca. 9.

Stems few, ascending, 6–17 cm. high; basal leaves numerous, crowded, spreading, 1.2–2 cm. long, 2.5–6 mm. wide; stem leaves 1–2 cm. long, 2.5–4

[5] Contr. U. S. Nat. Herb. **26**: 236. 1930.

[6] Contr. U. S. Nat. Herb. **26**: 237. 1930.

mm. wide, sessile, not decurrent, the lower spatulate, the upper linear-oblong, all obtuse, not appendaged; glomerule involucrate by a few lanceolate or ovate leaves about 7 mm. long; phyllaries 0.6–0.8 mm. wide, somewhat woolly below middle, the tips radiating in age; pistillate corollas 2 mm. long, their achenes subfusiform, 1 mm. long, glabrous, the pappus of about 20 minutely roughened bristles 2.8 mm. long, not thickened upwardly, lightly connate in a ring at extreme base; disk corollas apparently brownish above, slender-funnelform, 2.8 mm. long, 5-toothed, the style shortly bifid with truncate hispidulous tips, the pappus bristles about 25, 2.8 mm. long, finely hispidulous, connate at base, apparently deciduous in groups.

VENEZUELA: Páramo Quirorá, Mérida, alt. 2900 m., 24 Feb. 1922, *A. Jahn* 883 (type no. 1,186,590, U. S. Nat. Herb.); Páramo del Jabón, Trujillo, alt. 3500 m., 2 Oct. 1910, *Jahn* 22.

An interesting plant, possessing much the appearance of *Gnaphalium antennarioides* DC. (*Elychrysum gnaphalioides* H. B. K., *Antennaria monoica* Wedd., *Leontopodium gnaphalioides* Hieron.), and probably most closely related to that species. In *G. antennarioides* the plant is stoloniferous and the leaves are longer, glabrescent and green or greenish above, and tipped with a brown callous point.

Gnaphalium greenmanii Blake, nom. nov.

Gnaphalium linearifolium Greenm., Proc. Amer. Acad. 32: 308. 1897. Not *G. linearifolium* (Wedd.) French. 1892.

Clibadium psilogynum Blake, sp. nov.

Sect. *Euclibadii;* caulis strigosus; folia ovata opposita acuminata basi rotundata serrata triplinervia supra aspera subtus strigosa, petiolo tenui ca. 1.5 cm. longo; panicula terminalis densa; capitula mediocria sessilia; phyllaria 5–6 orbiculari-ovata obtusa v. minute apiculata sparse strigillosa sursum ciliolata 7–13-nervia; flores fem. 4, hermaph. 7–8; ovaria glaberrima.

Presumably a shrub; stem slender, terete, rather densely strigose with slightly tuberculate-based hairs; internodes 5.5–9 cm. long; petioles strigose, naked, 8–16 mm. long; blades 7.5–12 cm. long, 4–5 cm. wide, usually falcately acuminate, papery, dull green both sides, above evenly strigose or antrorsely short-hispid with tuberculate-based hairs, beneath evenly strigose on veins and surface, densely so on costa, serrate nearly throughout with small acute teeth (about 1 mm. long, 3–6 mm. apart), tripli- or subquintuplinerved, slightly prominulous-reticulate beneath; panicle dense, many-headed, 3 cm. wide, its hair looser than those of stem, mostly erectish; heads obovoid-oblong, about 8 mm. high (including corollas but excluding stamens), 4 mm. thick; involucre 6 mm. high; phyllaries 4.5–5 mm. long, 4–5 mm. wide; pistillate flowers 4, of which 3 are paleate, with pales similar to the inner phyllaries, the corollas white, glabrous, 4-toothed, 3 mm. long, the ovaries strictly glabrous, obovoid, 2 mm. long; hermaphrodite flowers 7–8, of which 1 is sometimes provided with a small pale, their corollas white, hispidulous on teeth, 3.8 mm. long (tube 1 mm., throat campanulate, 2 mm., teeth deltoid, 0.8 mm.), their ovaries linear-prismatic, 3 mm. long, glabrous or with a very few hairs at apex.

PERU: Marcapata Valley, near Chilechile, Prov. Quispicanchi, Dept. Cuzco, 21 Feb. 1929, *A. Weberbauer* 7864 (type no. 1,442,738, U. S. Nat. Herb.).

Related to *C. leiocarpum* Steetz and *C. anceps* Greenm., and distinguished by its combination of strigose branches and crowded but not glomerate heads.

Rudbeckia californica var. **glauca** Blake, var. nov.

Folia glauca margine tuberculato-hispidula ceterum glabra; phyllaria margine hispidula ceterum glabra vel subglabra.

OREGON: Just west of Cornutt, Douglas Co., 26 July 1918, *W. E. Lawrence* 2102; Rogue River Valley, 12 July 1887, *T. Howell;* near Wimmer, Jackson Co., 22 July 1892, *E. W. Hammond* 207; upland marshes near Waldo, 5 June 1884, *T. Howell.*

CALIFORNIA: One clump along brook, about 20 miles NE. of Crescent City, Del Norte Co., on road to Grants Pass, 30 Aug. 1927, *S. F. Blake* 10377 (type no. 1,488,180, U. S. Nat. Herb.); eight miles south of Waldo (Oregon), Del Norte Co., 14 June 1904, *C. V. Piper* 6103; Mt. Eddy, Siskiyou Co., 30 Aug. 1912, *A. Eastwood* 2047; same locality, 1 Sept. 1913, *L. E. Smith* 557; same locality, alt. 1675 m., 8 Sept. 1903, *E. B. Copeland* (distr. C. F. Baker 3862); railroad to Castle Lake, Siskiyou Co., 4 July 1913, *L. E. Smith.*

Typical *Rudbeckia californica* A. Gray, with the leaves green and rather evenly pubescent on both surfaces, especially beneath, with soft or rough hairs, and with dorsally pubescent phyllaries, is confined, so far as indicated by the material in the U. S. National Herbarium, to the Sierra Nevada of California from Tulare to Eldorado Counties. The form occurring on Mt. Eddy and in the Siskiyous appears very distinct in its usually glaucous and thicker leaves which are hispidulous on margin but glabrous on the surface, but in the absence of any observed distinctions in other characters, beyond a similar difference in the pubescence of the phyllaries, it does not seem to merit specific rank. In two sheets of the northern plant (*Hammond* 207 and *Lawrence* 2102) the leaves are sparsely strigose or hirsute on the costa beneath or on both sides and not obviously glaucous. All the specimens from Siskiyou County have somewhat thinner, coarsely dentate stem leaves; those of the other specimens cited, including the type, are thicker and entire or subentire.

Wedelia ambigens Blake, sp. nov.

Herbacea (?); caulis obtuse quadrangularis 4-sulcatus in angulis strigillosus; folia opposita ovata falcato-acuminata basi late rotundata triplinervia supra asperula subtus submolliter griseo-pubescentia crenato-serrata, petiolo tenui; capitula mediocria flava radiata pauca irregulariter cymosa; involucri ca. 7 mm. alti gradati phyllaria basi pallida indurata, apice herbaceo lanceolato acuminato squarroso subaequali; radii ca. 11, ca. 1.5 cm. longi; paleae rigide acuminatae; pappus coroniformis non stipitatus.

Sometimes subscandent; stem pithy, about 3 mm. thick; internodes usually 7–16 cm. long; petioles strigose or strigillose and somewhat hispid, 1–3.5 cm. long; blades 9.5–15 cm. long, 5–8.5 cm. wide, usually unequal at base, crenate-serrate (teeth small, acute, usually 1.5–4 mm. apart), thin, above deep green, antrorse-hispid with slightly tuberculate-based hairs and minutely tuberculate-hispidulous, beneath paler green or in youth griseous, rather densely hirsute-pilose with antrorse or spreading hairs (denser and longer along the veins) and sessile-glandular, triplinerved 5–10 mm. above base (sometimes with 2–3 pairs of weaker veins below) and loosely prominu-

lous-reticulate beneath; cymes terminating stems and branches, irregular, 3–4-headed, the peduncles normally 1-flowered, 3–7.5 cm. long, densely strigose or erectish-pubescent, usually naked, slender; heads 2.5–3.5 cm. wide; disk about 6–8 mm. high, 1–1.2 cm. thick; involucre about 3-seriate, slightly graduate or subequal, the phyllaries lanceolate to lance-ovate, about 2 mm. wide, densely pubescent outside with subappressed hairs, the base indurated, 3–5-vittate, the squarrose herbaceous apex subequal or somewhat shorter; rays about 11, yellow, pistillate, the tube 1 mm. long, the lamina narrowly oblong, 2-dentate, sparsely hirsutulous at base and along nerves of back, 11–13-nerved, about 15 mm. long, 3–5 mm. wide; disk flowers numerous, their corrollas yellow, hispidulous above, about 6 mm. long (tube 1.5 mm., throat funnelform, 3 mm., teeth elongate-triangular, acuminate, 1.6-1.8 mm. long); receptacle flattish; pales of medium breadth, densely and minutely hispidulous on keel and above, ciliolate and sparsely hispid on margin above, firm, gradually narrowed into a stiff acuminate tip, about 5 mm. long; ray achenes plumply trigonous, minutely hispidulous at the subtruncate apex, 2 mm. long, 1.6 mm. wide, their pappus a thick denticulate crown about 0.3 mm. high; disk achenes plump, compressed, obovoid, broad-based, minutely hispidulous and obscurely biauriculate at the subtruncate apex, 2.3 mm. long, 1.8 mm. wide, their pappus a thick denticulate crown 0.3 mm. high; style branches tipped with subulate acuminate hispidulous appendages about 0.4 mm. long.

VENEZUELA: Hills, vicinity of Cristobal Colon, 5 Jan.–22 Feb. 1923, *W. E. Broadway* 149 (type no. 1,188,477, U. S. Nat. Herb.), 591; Chacaito Gorge, around Caracas, 24 April 1921, alt. 800–1000 m., *H. Pittier* 9487; forming thicket in damp shady places, descent from Valera to Motatan Bridge, on road to Carvajal, Dept. Trujillo, 21 Nov. 1922, *Pittier* 10754.

Like *W. penninervia*, to which it is not remotely related, this species has much the aspect of *Wulffia*. It is readily distinguished from *W. penninervia* by its triplinerved leaves and different stem pubescence. From *W. latifolia* DC., of Colombia, with which *W. heterophylla* and *W. symmetrica* Rusby are probably identical, it differs in stem, involucre, pales, pappus, and pubescence.

Wedelia penninervia Blake, sp. nov.

Herba (?); caulis quadrangularis 4-sulcatus dense breviterque patenti-hirsutus; folia opposita ovata majuscula acuminata base late rotundata crenato-serrata supra asperula subtus dense moliterque griseopilosa, petiolo nudo ca. 2.5 cm. longo; capitula mediocria apice caulis ca. 5–6 irregulariter cymosa pedunculata; involucri ca. 3-seriati paullum gradati ca. 7 mm. alti appressi phyllaria late ovata acuminata dense subappresse pubescentia subherbacea; radii ca. 14, 9 mm. longa; paleae rigide acuminatae; pappus coroniformis non stipitatus.

Stem ca. 3 mm. thick, obtusely 4-angled, usually deeply 4-sulcate, pithy, densely and rather harshly short-hirsute with spreading hairs about 0.7 mm. long, glabrescent below; internodes mostly 4–6 cm. long, sometimes greatly elongated; petioles pubescent like the stem, 1.5–2.8 cm. long; blades 10–17.5 cm. long, 4.5–7.5 cm. wide, falcate-acuminate, broadly rounded and usually slightly unequal at base, crenate-serrate nearly throughout (teeth acute, small, mostly 2–5 mm. apart), subchartaceous, above deep green, evenly antrorse-hirsute on surface, more densely so on veins, with minutely tubercu-

late-based hairs, beneath densely and uniformly pilose with antrorse or erect minutely tuberculate-based hairs, featherveined, the ca. 8–10 pairs of chief veins and the secondaries impressed above, prominulous-reticulate beneath; pedicels densely pubescent like the stem, at first only 1.5–3 cm. long, at length 3.5–6 cm.; heads hemispheric-campanulate, in anthesis 2.5 cm. wide; disk 8–9 mm. high, 1.5–1.8 cm. thick; phyllaries somewhat glabrescent below, 2.5–3.8 mm. wide, slightly indurate at base; rays about 14, yellow, pistillate, the tube obscurely puberulous, 1.5 mm. long, the lamina elliptic-oblong, unequally 2-dentate, puberulous on back and hirsutulous on the 2 chief nerves, 9–11-nerved, 9 mm. long, 3.5 mm. wide; disk flowers numerous, yellow, their corollas hispidulous above, 6 mm. long (tube 1.7 mm., throat cylindrid-funnelform, 3.1 mm., teeth triangular-ovate, 1.2 mm. long); pales hispidulous on keel, ciliolate above, gradually tapering into the stiff subulate erect tip, about 7 mm. long; ray achenes plumply trigonous, 2.5 mm. long, 2 mm. wide, puberulous on the subtruncate apex, auriculate on the 2 outer angles at apex, the pappus at first of 3 toothlike awns about 0.5 mm. long and a lacerate crown of connate squamellae about half as long, at maturity reduced to a denticulate crown about 0.3 mm. high; disk achenes plumply quadrangular, 3 mm. long, 2 mm. wide, puberulous on the truncate-rounded apex, their pappus a lacerate crown about 0.3 mm. high, about a third as broad as apex of achene; style branches tipped with a subulate acuminate appendage about 0.7 mm. long.

COLOMBIA: Thicket in quebrada, Cordillera Oriental, east of Neiva, Dept. Huila, alt. 800–1000 m., 31 July 1917, *H. H. Rusby & F. W. Pennell* 410 (type in herb. N. Y. Bot. Gard.; photog. and fragm., U. S. Nat. Herb.); in quebrada, same locality and date, alt. 700–1500 m., *Rusby & Pennell* 513 (N. Y. Bot. Gard.).

A plant suggestive of some forms of *Wulffia* in appearance, and distinguished from related species of its region by its involucre and its penninerved leaves, which are densely and softly pubescent beneath. The smaller leaves are occasionally somewhat triplinerved through the enlargement of about the third pair of veins above the base. The type collection is described as a shrubby vine, the other collection as an herb. The plant is probably herbaceous or suffrutescent and occasionally leaning or subscandent.

Wedelia trilobata var. **pilosissima** Blake, var. nov.

Planta habitu, foliis trilobatis, pedunculis brevibus, etc., formae typicae *W. trilobatae* (L.) Hitchc. valde similis, differt caule densissime patenti-piloso pilis ca. 2 mm. longis.

PERU: Pebas, July 1929, *L. Williams* 1913 (type no. 1,444,044, U. S. Nat. Herb.); La Victoria, Aug.–Sept. 1929, *Williams* 2587; Caballo-Cocha, Aug. 1929, *Williams* 2313.

All the localities cited for this variety are on the Amazon River in the Department of Loreto.

Wedelia brasiliensis var. **villosa** (Baker) Blake.

Wedelia paludosa var. *villosa* Baker in Mart., Fl. Bras. 6^3: 181. 1884.

A specimen without data collected in 1921 by the Mulford Biological Exploration of the Amazon Basin (no. 2172) agrees with Baker's description

of this variety. I have elsewhere shown[7] that the name *Wedelia paludosa* DC. must be replaced by *W. brasiliensis* (Spreng.) Blake, based on *Acmella brasilensis* Spreng.

Helianthus anomalus Blake, sp. nov.

Herba, basi invisa; caulis albidus ramosus sparse breviterque tuberculato-hispida; folia alterna ovata v. lanceolato-ovate obtusa v. acuta basi cuneata integra 3-nervia crassa subcoriacea laete viridia tuberculato-hispidula, petiolo tenui longo; capitula 1–2 majuscula; involucri 2-seriati ca. 2 cm. alti gradati phyllaria lineari-lanceolata acuminata sparse tuberculato-hispida ad basim subciliata erecta discum superantia; radii flavi ca. 10 ca. 2 cm. longi; corollae disci tenues, dentibus purpureis; achenia disci appresse pilosa; pappus e aristis ca. 18 inaequalibus 1.2–4.5 mm. longis caducissimis compositus.

Plant 30 cm. high and more; stem stoutish, 4 mm. thick, leafy, rather sparsely short-hispid with white, tuberculate-based, upcurved conic hairs about 1 mm. long; internodes mostly 1.5–3 cm. long; petioles narrowly cuneate-margined at apex, 1.2–3.3 cm. long, pubescent like the stem; blades 4.5–8 cm. long, 1.2–3.2 cm. wide, cuneate or cuneate-rounded at base and then shortly and narrowly decurrent on apex of petiole, thick and rigid, evenly hispid or hispidulous on both surfaces with short conic tuberculate-based white hairs, those on the margin with extremely swollen bases; peduncles solitary at apex of stem and in the uppermost axils, 4–9 cm. long, slender, pubescent like the stem; heads about 5 cm. wide; disk hemispheric, about 1.5 cm. high. 1.5–2 cm. wide, smaller in reduced heads; involucre 1.7–2.7 cm. high, of about 16 linear-lanceolate acuminate herbaceous phyllaries, indurate at extreme base, 1-vittate, sparsely tuberculate-hispid and more or less definitely hispid-ciliate especially below, 1–2 mm. wide; rays yellow, 1.8–2.3 cm. long, 6–9 mm. wide, 11–13-nerved, emarginate; disk corollas stipitate-glandular and sparsely hispidulous on tube, finely hispidulous on base of throat and teeth, greenish white with purple teeth, 6.8–7.5 mm. long (tube 1.5–1.8 mm., throat cylindric-funnelform, 4.3–5.2 mm., teeth deltoid-ovate, 0.8 mm. long); pales scarious, hispidulous toward apex, usually 3-lobed, the lateral lobes merely small teeth, the median about 4 mm. long, acuminate, subulate-pointed, sometimes purplish-tinged at tip; ray achenes inane, their pappus much as in the disk; disk achenes oblong, plump, 4.5 mm. long, 1.8 mm. wide, mottled black and white, appressed-pilose with fulvous hairs; pappus of 2 slender hispidulous awns 4–4.5 mm. long and on each side between them about 6–8 similar unequal awns 1.2–3.5 mm. long, the whole caducous; style branches purplish, hispid dorsally, tipped with a linear-subulate obtusish hispidulous appendage about 0.8 mm. long.

UTAH: Desert south of Hawksville, Wayne Co., alt. 1370 m., 5 July 1930, *W. D. Stanton* 328 (type no. 1,487,743, U. S. Nat. Herb.; dupl. in herb. Brigham Young University, no. 4806).

A very interesting plant, amply distinct in characters of foliage and involucre, and remarkably set off from all other known species by its pappus, which carries to an extreme the tendency found in various other species to produce additional squamellae between the two constantly present marginal awns. Further specimens showing the base of the plant are much to be desired.

[7] Contr. U. S. Nat. Herb. **26**: 250. 1930.

Enceliopsis covillei (A. Nels.) Blake.

Helianthella argophylla Coville, Contr. U. S. Nat. Herb. **4**: 132. 1893, as to descr. only. (Not *H. argophylla* (D. C. Eaton) A. Gray.)
Encelia grandiflora Jones, Proc. Calif. Acad. II. **5**: 702. 1895. Not **E.** *grandiflora* (Benth.) Hemsl. 1881.
Helianthella covillei A. Nels., Bot. Gaz. **37**: 273. 1904.
Enceliopsis grandiflora A. Nels., Bot. Gaz. **47**: 433. 1909; Blake, Proc. Amer. Acad. **49**: 354. 1913.

Oyedaea oxylepis Blake, sp. nov.

Suffrutescens (?); Caulis strigosus; folia opposita elliptico-oblonga crenato-serrulata acuta basi cuneata penninervia supra aspera subtus hirsuto-pilosa ca. 8 cm. longa 3 cm. lata; capitula minuscula saepius solitaria terminalia breviter pedunculata; involucri 5–7 mm. alti subaequalis ca. 3-triseriati phyllaria ovato-lanceolata acuminata strigosa, apice herbaceo patente supra lepidoto-hispidulo.

Stem (above) slender, brownish, striatulate, subterete, densely strigose or erectish-hirsute with slightly tuberculate-based hairs and between them sordid-pilosulous; upper internodes 3–6 cm. long; petioles about 3 mm. long, pubescent like the stem; blades (4) 6–8.5 cm. long (1.5) 2–3.2 cm. wide, acute or acuminate, callous-tipped, above harshly pubescent with antrorse-curved hairs with persistent lepidote bases, antrorse-hirsute along costa, beneath evenly but not densely hirsute-pilose with spreading or antrorse-curved hairs and gland-dotted, crenate-serrulate above the entire cuneate base with about 5–9 pairs of apiculate depressed teeth (3–8 mm. apart). firm-herbaceous, the principal lateral veins about 6–12 pairs, with the minor veins prominulous-reticulate beneath; peduncles terminal in forks of stem and branches, 1(–2)-headed, naked or 1-bracteate, 1–2.5 cm. long, pubescent like the stem; heads 2 cm. wide; disk (as pressed) 9–10 mm. high, 7–10 mm. thick; involucre slightly obgraduate or subequal, the 2 outer series of phyllaries lance-ovate, 2.5–3 mm. wide at base, strigose and strigillose, the somewhat longer herbaceous apex spreading at least in age, lepidote-hispidulous above, the innermost series with short bluntish subherbaceous tips; rays about 8, yellow, neutral, the tube 2.5 mm. long, sparsely hirsutulous, the lamina narrowly oblong, emarginate, with 4 principal nerves, 11 mm. long, 3 mm. wide; disk corollas not very numerous, yellow, essentially glabrous except on teeth, 6.5 mm. long (tube 2.3 mm., throat slender-funnelform, 3.5 mm., teeth ovate, 0.7 mm. long, sparsely hispidulous at apex, papillose on margin within); pales narrow, acute, densely hirsutulous at apex, about 6 mm. long; disk achenes (submature) oblong, compressed, blackish, 3 mm. long, sparsely strigose on the faces, densely hispidulous-ciliolate on margin, very narrowly winged on one margin, scarcely at all on other; pappus of 2 slender fragile hispidulous awns 2.5–3 mm. long and on each side between them about 4–6 short awns, connate at base, mostly about 1.1 mm. long, the lateral ones sometimes up to 1.5 mm. long.

PERU: "Weed" in forest, San Roque, Dept. San Martín, alt. 1350–1500 m., 7 Jan. 1930, *Llewelyn Williams* 6992 (type No. 629616, herb. Field. Mus.; dupl. No. 1,495,543, U. S. Nat. Herb.).

A member of a group of half a dozen closely related Andean species, of which the closest is probably the Bolivian *O. rusbyi* Blake. In the latter the heads

are numerous and the phyllaries have much shorter and relatively broader bluntish herbaceous tips.

Actinea helenioides (Rydb.) Blake.

Picradenia helenioides Rydb., Bull. Torrey Club **28**: 21. 1901.
Hymenoxys helenioides Cockerell, Bull. Torrey Club **31**: 481. 1904.
Dugaldia helenioides A. Nels. in Coult. & Nels., New Man. Bot. Rocky Mts. 562. 1909.

This species has continued to be known only from the type collection made at Sangre de Cristo Creek, south-central Colorado, alt. 2400–2700 m., 2 July 1900, by P. A. Rydberg and F. K. Vreeland (no. 5495). A considerable extension of range is shown by a specimen in the U. S. Forest Service herbarium collected on ridge running east from Castle Valley Ridge, about 5 miles southeast of Clearcreek, in the Manti Forest, Carbon Co., Utah, alt. 2930 m., 25 August 1914, by W. R. Chapline, Jr. (no. 80). Through the courtesy of Dr. E. D. Merrill, I have been able to compare with this specimen two sheets of the type collection in the herbarium of the New York Botanical Garden. In the original specimens the rays are not fully developed. Those of Mr. Chapline's plant have the lamina 1.8–2 cm. long and 4–6 mm. wide.

Dyssodia remota Blake, sp. nov.

Fruticulus diffusus; caulis obscure hirtellus ramosus; folia opposita pinnatipartita ca. 2.5 cm. longa, segmentis 5 lineari-ellipticis utrinque acutis glanduloso-crenatis glabris subcoriaceis; capitula terminalia solitaria mediocria flava radiata breviter pedunculata; involucri primarii 1 cm. alti 2-seriati aequalis phyllaria oblonga obtusa ad apicem ciliolata libera glandulosonotata, calyculo e. phyllariis ca. 5 parvis subulatis sistente praediti; pappi paleae ca. 15, quaque in aristas 2–4 dissecta.

"Half-trailing" undershrub, several-stemmed, about 30 cm. long; stems oppositely branched; branches slender, obscurely hirtellous somewhat in lines, leafy; internodes 0.4–3.5 cm. long; petioles narrowly margined, 3–6 mm. long, glabrous, bearing toward base 1–3 pairs of setaceous lobes 2.5 mm. long or less; blades ovate in outline, 1–3.3 cm. long, 1–1.8 cm. wide, divided to the narrowly winged rachis, the leaflets 3–5, the lateral 5–11 mm. long, 1–2.5 mm. wide, the terminal 0.8–2 5 cm. long, 2–4 mm. wide, all sessile but usually contracted at base, crenate with 2–4 pairs of very rounded teeth, a round yellowish gland in each notch; peduncles 1–1.5 cm. long, slender, glabrous; heads about 2–3 cm. wide; disk campanulate, 14 mm. high, 10 mm. thick; involucre double, the outer of about 5 narrowly subulate phyllaries 3–5.5 mm. long, ciliolate, sometimes with 1 or 2 linear-lanceolate lobes toward base, the inner of about 9 equal 2-seriate phyllaries, these oblong, obtuse (the outer 3 mm. wide, the inner 4.5 mm.), ciliolate above, otherwise glabrous, erose below, substramineous, with indurated and thickened extreme base, 1-ribbed, finely several-vittate, bearing usually a pair of subbasal linear oil glands and 1 or 2 shorter subterminal ones; receptacle flat; rays about 5, yellow, fertile, the tube 4 mm. long, puberulous, the lamina elliptic, entire or 2-denticulate, 7–9-nerved, 7.5 mm. long, 3 mm. wide; disk flowers about 38, their corollas yellow, cylindric-funnelform, puberulous near middle and on teeth, 7 mm. long (tube 2.8 mm., throat 2.8 mm., teeth triangular, 1.4 mm.

long); achenes of ray and disk similar, linear-cylindric, subterete or somewhat flattened, 4 mm. long, densely hirsutulous; pappus 6 mm. long, straw-color, 1-seriate, of about 15 paleae dissected nearly to base into 2–4 slender hispidulous bristles, the lateral bristles somewhat shorter than the inner; style branches with short deltoid obtusish subglabrous appendages.

PERU: Half-trailing on grassy canyon ledges or slopes, Llata, Dept. Huanuco, alt. 2135 m., 21 Aug. 1922, *Macbride & Featherstone* 2241 (type no. 518725, herb. Field Mus.; dupl. no. 1,186,055, U. S. Nat. Herb.).

Nearest *Dyssodia jelskii* Hieron., also of Peru, which is described as having cuneate-obovate merely dentate leaves and outer phyllaries (bracteoles) equalling the inner.

Cirsium rhothophilum Blake, nom. nov.

Carduus maritima (sic) Elmer, Bot. Gaz. **39**: 45. 1905.
Cirsium maritimum Petrak, Beiheft. Bot. Centralbl. **35**: Abt. **2**: 288. 1917. Not *Cirsium maritimum* Makino, Bot. Mag. Tokyo **24**: 249. 1910.

Petrak's reason for transferring Elmer's name to *Cirsium*, when at the same time he cited an earlier use of the name *Cirsium maritimum* by Makino for a new species described from Japan, is not obvious. At any rate, this very distinct species, known only from the type locality at Surf, Santa Barbara County, California, must receive a new name. The one here given (from *ῥόθος, the dash of waves*) refers to its habitat on sand dunes on the seacoast.

BOTANY.—*The genus* Lozanella.[1] E. P. KILLIP and C. V. MORTON U. S. National Museum.

Lozanella, a genus of Ulmaceae of the tribe Celtidoideae, was established by Greenman in 1905 and to it was referred a single species, *L. trematoides*, proposed at the same time and based upon a Pringle collection from Hidalgo, Mexico. Three years previously, however, Donnell Smith had described from Costa Rican material a species in the genus *Trema*, *T. enantiophylla*, which clearly is identical with *Lozanella trematoides*.

In the course of studies of tropical American Urticaceae which the senior author has been making, several specimens have been observed in unidentified material referred to that family which, though evidently representing a single genus, did not belong to Urticaceae. Comparison of these specimens with type material of *Lozanella trematoides* and *Trema enantiophylla* deposited in the National Herbarium shows that they represent two species of *Lozanella*, one the species described by Donnell Smith and by Greenman, the other new.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received June 1, 1931.

Of special note is the fact that the additional collections of the original species were made at widely separated localities, in Guatemala, in Costa Rica, in the Santa Marta Mountains and the Eastern and Western Cordilleras of Colombia, and in northern Peru. The second species has a more limited distribution, ranging from southeastern Peru to central Bolivia.

The tribe Celtidoideae is distinguished by its drupaceous fruit and curved embryos. *Celtis* and a few related genera are at once dis-

TABLE 1. CHARACTERS OF CERTAIN CELTIDOIDEAE

	Lozanella	Trema	Parasponia	Aphananthe	Gironniera	Chaetacme
Range	Mexico to Boliva	Throughout Old and New World Tropics	Malay Archipelago and Pacific Is.	Japan, Philippine Is., Australia	Eastern Asia and Pacific Is.	Africa
Cotyledons	Broad, scarcely curved, equal	Narrow, recurved, equal	Narrow, recurved	Narrow, recurved	Narrow, recurved	Narrow, recurved, unequal
Leaves	Opposite, serrate	Alternate, serrate	Alternate, serrate	Alternate, serrate	Alternate, entire or serrate	Alternate, entire
Stipules	United	Free	United	Free	United	United
Inflorescence	Dioecious	Frequently monoecious	Frequently monoecious	Dioecious	Dioecious	Dioecious
Aestivation	Imbricate or slightly valvate above	Valvate or slightly imbricate above	Imbricate	Valvate	Imbricate	Valvate
Endosperm	Fleshy	Fleshy	Fleshy	Thin or none	Fleshy or none	Practically none
Other characters	Branches all opposite		♀ flowers solitary		♀ flowers cymose or solitary	Spines present

tinguished by their broad, contorted cotyledons. The remaining genera of the tribe have uncontorted narrower cotyledons. They are: *Trema*, *Parasponia*, *Aphananthe*, *Gironniera*, and *Chaetacme*. The relationship of *Lozanella* to these genera, which other than *Trema* are all Old World, is far from clear. They all have alternate leaves and narrow recurved cotyledons, whereas *Lozanella* has opposite leaves and broad, scarcely curved cotyledons. The united stipules of *Lozanella* are found also in *Parasponia*, *Gironniera*, and *Chaetacme*.

The opposite branches of *Lozanella* are characteristic. The various characters are summarized in Table 1.

KEY TO SPECIES OF LOZANELLA

Mature leaves densely pubescent beneath, the hairs yellowish; petioles and rachises densely pubescent; pistillate inflorescences simple or with short lateral branches, the flowers congested; perianth lobes much imbricate ..... 1. **L. permollis.**

Mature leaves not densely pubescent beneath, the hairs whitish; petioles and rachises sparingly pubescent; pistillate inflorescences conspicuously branched, the flowers solitary or clustered; perianth lobes imbricate below, becoming somewhat induplicate-valvate above..... 2. **L. enantiophylla.**

Lozanella permollis Killip & Morton, sp. nov.

Arbor inermis dioica; caules pubescentes; folia opposita, elliptica, petiolata, apice acuminata, basi late obliqueque cuneata, serrata, basi integra, supra scabra, subtus molliter lanata, nervis reticulatis, stipulis caducis, intraaxillaribus, in ramis cicatrices circulares conspicuas reliquentibus; ♂ inflorescentia cymosa, ramosa, floribus aggregatis, pedicellis brevibus, bracteatis; perianthium 5-partitum, laciniis imbricatis, carinatis, obtusis, ciliatis; stamina 5, perianthii laciniis opposita, hypogyna, sub disco piloso inserta, aestivatione erecta; filamenta subulata, exserta; antherae dorso supra basim adfixae, introrsae; ♀ inflorescentia axillaris, ramis lateralibus nullis vel brevibus; rachis dense pubescens; flores sessiles; perianthii laciniae aequales, oblongae, sub fructu persistentes; staminodia nulla; drupa parva, monosperma, stylis marcescentibus coronata; ovulum unum, pendulum.

Dioecious tree about 8 meters high; branches of previous season terete, sparingly pubescent, leafless; branches of the season leafy, more pubescent, increasingly so toward the growing tip, the hairs dense, matted, ferruginous; stipules united around the stem, caducous, leaving conspicuous circular scars; petioles flattened, 1.5 to 4 cm. long, densely spreading yellow-pubescent; leaves opposite, elliptic, broadest at middle, the blades 9 by 4 cm. to 17.5 by 8.5 cm., acuminate at apex, broadly cuneate and oblique at base, conspicuously serrate (teeth curving toward apex), entire near base, above dark green, prominently scabrous, the hairs white, pustulate, beneath paler, densely pubescent, the hairs appressed, long, yellowish, confined to the veins and veinlets (young leaves velvety pubescent), conspicuously reticulate-venose beneath, 3-nerved from the base, the midnerve giving rise to about 3 pairs of secondary veins, the two outer nerves exteriorly to 7 or 8 secondary veins, the principal nerves impressed above; staminate inflorescences cymose, several in each leaf axil, divaricately branched, the flowers borne in small clusters, the peduncle about 1 cm. long, with dense pubescence similar to that of stem and petiole, the pedicel very short or subobsolete, bracteate; perianth 5-lobed, the lobes 3 mm. long, about 1.6 mm. wide, obtuse, scarious-margined, conspicuously carinate, free almost to base, prominently imbricate in bud, sparingly pubescent on both sides, long-ciliate; hypogynous disk present, densely long white-hairy; stamens borne on border of disk, 5, opposite perianth segments; filaments 3 mm. long at maturity, subulate, glabrous, exserted; anthers erect from the beginning, introrse, oval, 1.2 mm. long; rudimentary ovary present, small; pistillate inflorescences several in each leaf axil, not divaricately branched, the lateral branches none or very short,

the peduncle about 1 cm. long, densely pubescent like the petioles, the flowers borne in sessile clusters along the pubescent axis; flowers sessile; perianth segments 5, equal, imbricate, oblong, 1 mm. long, about 0.7 mm. wide, obtuse, sparingly pubescent on both sides, ciliate, persistent and becoming fleshy in fruit, the base then rather stipitate; hypogynous disk present, fleshy, densely long white-hairy; staminodia none; fruit a drupe, about 1 mm. wide and long, compressed laterally, green, glabrous, the flesh thin; styles 2, conspicuously hairy, about 1 mm. long, persistent on the fruit; seed oval, compressed, yellow, the pericarp thin; ovule solitary, pendulous from the summit of ovary; embryo immature.

Type of staminate plant in the U. S. National Herbarium, no. 1,156,898, collected at Unduavi, South Yungas, Department of La Paz, Bolivia, November, 1900, altitude 3100 meters, by O. Buchtien (No. 2814). Additional material of this collection, U. S. N. H. No. 1,044,987.

Type of pistillate plant in the U. S. National Herbarium, no. 1,156,897, collected at same time and place by O. Buchtien (No. 2815). Additional material of this collection, U. S. N. H. No. 1,044,988.

Additional specimens examined: BOLIVIA: COCHABAMBA: Incachaca, Province of Sacaba, 2500 meters alt. *Steinbach* 5788 (F[2]), 5819 (F). PERU: CUZCO: Lucumayo Valley, *Cook & Gilbert* 1376 (N).

Lozanella enantiophylla (Donn. Smith) Killip & Morton.

Trema enantiophylla Donn. Smith, Bot. Gaz. **33**: 259. 1902.

Lozanella trematoides Greenm., Proc. Amer. Acad. **41**: 236. 1905.

Specimens examined: MEXICO: HIDALGO: Near Honey Station, *Pringle* 8983 (N, type collection of *L. trematoides*). Barranca below Trinidad Iron Works, 1,550 meters alt., *Pringle* 13607 (N). GUATEMALA: CHIMALTENANGO: Volcán Acatenango, 2500 meters alt., *Kellerman* 6611 (F). COSTA RICA: HERIDA: Cerros de Zurquí, northeast of San Isidro, 2,000–2,400 meters alt., *Standley & Valerio* 50357 (N). SAN JOSÉ: Río Pedregoso, near El Copey, 1800 meters alt., *Tonduz* (Donn. Smith 7517B, Inst. Nat. Costaric. 11734, N). CARTAGO: Estrella, *Cooper* 325 (Donn. Smith 5949, N, type). El Muñeco, Río Navarro, 1,400–1,500 meters alt., *Standley & Torres* 51108 (N). COLOMBIA: MAGDALENA: Santa Marta Mountains, *H. H. Smith* 1437 (N). SANTANDER: Las Vegas, 2,600 meters alt., *Killip & Smith* 16133 (N). CALDAS: Río San Rafael, below Cerro Tatamá, 2,600–2,800 meters alt., *Pennell* 10373 (N). PERU: LIBERTAD: Río Mishiolla Valley, Province of Pataz, 2,000 meters alt., *Weberbauer* 7049 (F, N).

Standley notes that this is a shrub or tree, 3 to 5 meters high; Weberbauer that it is a shrub 7 meters high. The plant observed in the Eastern Cordillera of Colombia by Mr. Smith and the senior author was a tree 5 to 6 meters high, with a rather slender trunk and a rounded crown.

[2] F, Field Museum of Natural History; N, U. S. National Herbarium.

NECROLOGY.—*Raoul Gautier.*[1] GEORGES PERRIER, Secretary of the International Association of Geodesy. (Communicated by WILLIAM BOWIE.)

The International Association of Geodesy wishes to express, by my voice, the feeling of gratitude of all geodesists towards Raoul Gautier, their promise to treasure his memory faithfully while striving to follow his example.

Grandnephew of Alfred Gautier, the founder and first Director of the new Observatory of Geneva, son of Emile Gautier, who was its Director from 1883 to 1891, Raoul Gautier continued the glorious tradition of his family. Even if his work was mainly astronomical, many branches of geophysics, for example meteorology, are indebted to him for notable contributions.

But it was in geodesy that he played a rôle of particular importance. It is now forty years since, upon the death of his father, he joined the Swiss Geodetic Commission, created in 1861, forty years during which his geodetic activities have not flagged for a single instant.

Accredited representative of Switzerland, after the death of Hirsch, to all of the general assemblies of the old International Geodetic Association—Copenhagen (1903), Budapest (1906), London (1909), Hamburg (1912)—he acquired an undisputed authority among all the geodesists who attended these great tribunals of our science. Many of them are now gone but the survivors gladly recall these reunions, stamped with the impress of his kindly cordiality, where the geodesists formed one great, united family and where Gautier's influence again and again asserted itself.

Then came the somber days of the War, involving the dissolution of the old Association. It was a cruel blow to Gautier, who was profoundly attached to it but, with a few friends belonging to countries which, like Switzerland, were not involved in the terrible conflict, with admirable clear sightedness, he saw his duty plainly: to strive to maintain the spark which would later serve to rekindle the extinguished torch of international geodetic work. From this idea was born the Reduced Geodetic Association, created by the Neutral Countries, of which he became President and which carried on as far as possible the work of the vanished Association and, in particular, insured the continuance of the observations and computations of the important International Latitude Service.

[1] Address delivered at the funeral services of Prof. RAOUL GAUTIER, vice-president of the International Association of Geodesy, at the Protestant Church of Cologny, near Geneva, April 22, 1931. Translated by ADRIENNE ERVIN. Received June 6, 1931. Prof. Gautier was a member of the Washington Academy of Sciences.

Moreover, after an international conference held by the Allies and Neutrals at Brussels in 1919, he made a reality of the lofty conception of new international scientific unions, branches of a supreme council, the International Research Council, and when Raoul Gautier went to Rome in 1922 to attend the first General Assembly of one of these unions, the International Union of Geodesy and Geophysics, he was unanimously elected Vice President of the Section (now called Association) of Geodesy, an office that he held until his death.

Since that time, I have had the honor of collaborating intimately with him, as is shown by an active correspondence with him, which I shall never hereafter read over without emotion and heaviness of heart. The part played by Gautier was most difficult; to us geodesists of the succeeding generation he stood as the one who continued the traditions of the old Association and as a bond between the past and the present.

I can say that, always and everywhere, he was inspired by love of his country and by the higher interests of science. If the old Section of Geodesy of the Union, transformed to-day by the change of too modest a title into the International Association of Geodesy, now stands as a powerful organization that includes 37 civilized countries, it is due in large part to the mollifying influence and eminent authority of Raoul Gautier.

Alas, most of our colleagues of the Association saw him for the last time, four years ago, at the General Assembly in Prague. Age and the prudence imposed on him by attacks of an illness which impeded his physical activity without in any way diminishing his mental activity were the reasons which, notwithstanding his sincere desire to attend the General Assembly at Stockholm last year, forbade his going there. We missed him greatly. His experience, his shrewd grasp on the realities, his poise, would have been very useful to us at a difficult period in the existence of our Association, the moment of the renewal of the Statutes. I recall with what interest he heard the account that I gave him of our work, as he judged with serene impartiality our discussions and our decisions.

In the address that we sent him when, on February 25, 1928, his colleagues and friends in Geneva organized a ceremony in his honor on the occasion of his retirement, we expressed the wish and the hope that, for many years to come, he might aid us by his eminent experience and his counsel. That hope has been denied, but the memory of his life so nobly lived will remain for us a very real inspiration.

My dear Vice President, I bid you farewell, in the name of our President, Mr. Bowie, of your colleagues, of our Executive Committee, and of the geodesists who were your friends and who, at this very moment, feel as a cruel shock the news of your death.

Farewell!

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

ANTHROPOLOGICAL SOCIETY

631ST MEETING

The 631st meeting of the Anthropological Society of Washington was held on Tuesday, March 17, 1931, at 4:45 P.M., in Room 42–43, National Museum, President JOHN M. COOPER, presiding.

Program: FRANK M. SETZLER: *The Mound-Builder cultures of the Upper Mississippi Valley* (illustrated).—A review of the archeological cultures in Ohio, Indiana, Kentucky, Illinois and Wisconsin follows.

In Ohio three important mound-building cultures have been established. *Hopewell*, the most spectacular, is characterized by extensive and complex earthworks in geometric forms covering from one to one hundred acres; by mounds varying in height from one foot to thirty feet, usually covering the remains of wooden structures; by burials, the majority of which are cremated, though a minority are extended type placed in prepared graves of earth and log structures. Artifacts with the burials are for the most part made of material foreign to Ohio—obsidian, copper, mica, tortoise shell, galena, grizzly bear teeth, and hematite. Platform pipes show a high degree of sculpture; terra cotta figurines depict the costumes of the people. The skulls are predominantly dolichocephalic and show no evidence of artificial cranial deformation.

The *Fort Ancient* culture is the most extensive of the Ohio group. The mounds are small, and numerous village sites have yielded the majority of artifacts. Most of the burials are in cemeteries. Artifacts are of bone and shell primarily, and of other indigenous materials. This is the only culture in Ohio in which European objects have been found, which leads Dr. Swanton to believe that one of the sites—Madisonville—was inhabited by the Monsopelia.

The *Adena* culture is now considered a group distinct from the Hopewell. The mounds are usually conical and occur singly and unaccompanied by earthworks. Burials are made throughout the mound, frequently an important central grave occurring below the base line. Materials from distant sources were extensively used, and copper was employed only for ornamental objects, such as bracelets, finger rings, and gorgets. Other artifacts were tubular pipes and projectile points of the unnotched stemmed type.

In Indiana in the southeastern part a systematic survey and mound excavation revealed cultures similar to the Fort Ancient and Adena of Ohio. A mound in the southwestern part of the state exhibited characteristics evident in Lower Mississippi groups. Early reports indicate the possibility of a culture related to Hopewell.

In Kentucky along the Ohio River are cultures closely allied to the Fort Ancient. In the mountainous region of eastern Kentucky the rock shelters and caves contain ash layers at the bottom of which is the most primitive culture of the Mississippi region yet found. Even though "hominy holes," charred corn and gourd shards indicate that agriculture was practiced, there is no evidence of pottery. On the surface, however, pottery, woven fabrics and well fashioned artifacts appear. This pottery closely resembles that of the historic Cherokee. The culture in the central part of the state is characterized by truncated and domiciliary mounds and stone boxlike graves, traits which belong to the Tennessee-Cumberland cultures to the south.

In Illinois there are five cultures. The Cahokia, near St. Louis, is a northern extension of a southern culture, probably Etowah. Along the Illinois River there are two cultures, one known as the *Bluffs*, the other new and unnamed, which is likely the oldest in the state, characterized by an extremely long-headed people. Bordering the Mississippi River from Iowa to the junction of the Spoon River with the Illinois, there is a highly developed Hopewell culture. In the northwest corner of the state is the southern extremity of the effigy culture, which centers in Wisconsin.

Wisconsin contains four distinct archeological groups. The most widespread is known as the *Lake Michigan* culture, of which the effigy mounds are a sub-group. We find clay pipes, stone altars, bone harpoons, needles, and scrapers. The pottery strikingly resembles that of the eastern woodland Algonquin tribes. A rather extensive village-dwelling culture known as Upper Mississippi consists of triangular arrow points, snub nosed scrapers, flat stone grinding mortars, Siouan type of stone pipe, bone and shell implements, burials in the flesh both extended and flexed. Historically known Winnebago sites have produced exclusively pottery similar to the Upper Mississippi ware.

A close variant of the Cahokia pottery has been found at Aztalan. This site is characterized by truncated mounds, ear spools of bone, stone and pottery, large chipped hoes, disc beads, shells, three-notched triangular arrowpoints and perforated shell implements. The pottery is painted and burnished; the vessels are of a great variety of shapes.

Along the Mississippi River in the southwestern part of the state a variant of the Ohio Hopewell is found, consisting of large conical burial mounds, burials made in rectangular bark lined pits covered with poles and bark slabs, beneath the floor of the mound. Artifacts consist of large chipped implements of obsidian and flint, pearl beads, copper beads, plates, ear spools, celt, and axes. Pipes are of the concave-based type. The pottery is surprisingly similar to that found in Ohio.

The greatest need at the present time is to show the relationship between the Upper and Lower Mississippi cultures, and more especially the tie-up between the prehistoric and historic Indian tribes. (*Author's abstract.*)

632ND MEETING

The 632nd meeting of the Anthropological Society was held at the National Museum April 21, 1931.

Program: W. M. WALKER, Bureau of American Ethnology: *Archeological reconnaissance in the Hawaiian Islands* (illustrated).—The island of Maui was chosen as representative of the culture prevailing in the Hawaiian Islands before the advent of the whites, and a survey of all existing ruins was made during a stay of nine months in 1928–29 under the provisions of a research Fellowship provided by the Bernice P. Bishop Museum of Honolulu.

Ancient evidences of Hawaiian culture are to be found only on the surface as there is little top soil covering the underlying lava formations on the sites of aboriginal occupation. There are indications of but one such occupation, although legendary accounts imply possibly two or more. Construction in stone made no use of cut or shaped blocks or mortar. Simple blocks and pieces of rough lava or water-worn stones were used where found to build the platforms and walled structures known as *heiau* and used as places of worship. Some 230 of these sites were found on Maui, exhibiting a great variety of size, shape, and plan,—no two being exactly alike. Orientation toward the sea was a more important consideration than toward the cardinal points, and the site chosen was generally on some headland with a commanding view of the shore; if down in a valley the heiau was walled to provide greater privacy for the sacred ceremonies. The largest site found measured 425 feet long, 340 feet wide, and had a terraced slope 50 feet high where it extended over the edge of the hill. This temple is attributed to a Maui chief of the 16th century, which is as far back as any of the ruins can be dated with any accuracy, although it is believed at least 500 years have elapsed since the last great traditional period of voyages took place from the southern Polynesian islands.

Besides the heiau, the villages contain house platforms on which the grass houses were built, platforms for other small buildings, animal pens, enclosures for canoes, terraces for the cultivation of taro, small patches for sweet potatoes, gourds, etc. At many places by the shore small platforms of rocks and coral known as *koa*, or fishermen's shrines were found. Four of the old grass houses in various conditions of decay are all that remain on the island. In the windy sections the houses had stone walls and only the roof was of thatch.

Other archeological features included paved stone foot trails crossing the wildest and rockiest parts of the lava flows, and attributed to the genius of a legendary hero; artificial fishponds formed by building barriers of rock across a narrow bay or cove; playgrounds, such as tracks prepared down grassy slopes for games of sled coasting, and bowling grounds for the game of *maika* played with stone discs; and battle sites such as impregnable rocky headlands and steep ridges, as well as battle fields in the sandhills, etc. Burials of important chiefs were made in inaccessible cliffs which are only discovered by chance as all knowledge of them is held in the greatest secrecy. Common people were buried in sandhills or in some deserted gulch, which is still the practice in many places.

A detailed account of the reconnaissance will be published by the Bishop Museum of Honolulu.

FRANK H. H. ROBERTS, JR., *Secretary*

SCIENTIFIC NOTES AND NEWS

THE JOSEPH HENRY LECTURESHIP OF THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The Philosophical Society of Washington, through its General Committee, has decided to establish a lectureship in honor of its first President, JOSEPH HENRY. Such action at this time is particularly appropriate, since 1931 is the centenary of the discovery of electromagnetic induction, a discovery which has brought honor not only to Henry, but also to Faraday. The purpose and scope of the Lectureship can best be shown by quoting the report of the special committee, which was adopted by the General Committee.

"(1) There is at present in the hands of the Treasurer a cash balance . . . ., and the committee is in agreement that . . . . a portion of it be spent . . . . in some way which will advance the cause of science and reflect credit on the Society.

(2) It is proposed that at suitable intervals of time a speaker be selected to address the Society on one of the broad aspects of some field of science, the speaker to review the recent developments or present status of a subject included in or related to the Physical Sciences.

(3) It is further proposed that the complete address be put in form for publication and submitted to the JOURNAL of the Washington Academy of Sciences.

(4) It is further proposed that the aforementioned address shall be called the Joseph Henry Lecture in memory of the first President of the Philosophical Society.

(5) It is further proposed that the first Joseph Henry Lecture be delivered before the Society in the fall of 1931, and that thereafter the lecture shall be delivered annually before the Society in the spring of the year, starting in the spring of 1932.

(6) It is further proposed that the expenses of the speaker incidental to a visit to Washington shall be borne by the Society and that in addition an Honorarium of one hundred dollars ($100) shall be presented to the lecturer at a suitable time during his visit.

(7) The complete arrangements for any one meeting are to be made by a special committee of three who are to be responsible for selecting the speaker and securing the manuscript in form for publication. No member of the committee should have been a member of the immediately preceding similar committee."

The General committee further provided that the special committee for a given year shall be appointed before October 15 of the preceding year. In accordance with this action, the following committees have been appointed:

1931	1932
C. G. ABBOTT	L. J. BRIGGS, *Chairman*
L. H. ADAMS, *Chairman*	J. H. TAYLOR
R. E. GIBSON	F. E. WRIGHT

A transcontinental excursion from New York or Washington to San Francisco by airplane and return by train is being arranged for geomorphologists who will attend the International Geological Congress in 1933. The leader of the excursion will be Dr. A. K. LOBECK of Columbia University.

TAISIA STADNICHENKO and PARKER D. TRASK have been appointed associate geologists in the Geological Survey and assigned to the fuel section of the geologic branch.

M. N. SHORT, associate geologist of the Geological Survey, has been appointed professor of optical mineralogy at the University of Arizona.

Obituary

EDWARD GOODRICH ACHESON, of St. Petersburg, Fla., a member of the ACADEMY, died in New York, July 6, 1931, after a brief illness. He was born at Washington, Pa., on March 9, 1856, and at an early age became interested in experimental work. He was employed in Edison's laboratory from 1880 to 1882 in the development of filaments for the electric lamp. About 1891 he discovered a new chemical compound, silicon carbide, now known commercially as Carborundum, and in 1906 he devised a method of making colloidal graphite from it. For these and other discoveries, he was awarded many medals and prizes. The degree of Doctor of Science was conferred on him in 1909 by the University of Pittsburg. He was the founder and first recipient of the Acheson Medal, which is awarded by the American Electrochemical Society for a distinguished contribution in electrothermics.

FRANK WIGGLESWORTH CLARKE, a past president of the ACADEMY and for 42 years (1883–1925) Chief Chemist of the U. S. Geological Survey, died at his home in Washington May 23, aged 84 years. He was born in Boston March 19, 1847, and graduated from Harvard in 1867. He was professor of chemistry at the University of Cincinnati from 1874 to 1883 and had also taught at Cornell and Howard universities. Prof. Clarke was recognized as an international authority on atomic weights and as one of America's leading chemists. He was the recipient of several honorary degrees from universities both in this country and abroad. Prof. Clarke was one of the first to compile fundamental physical and chemical constants, and for many years he was chairman of the international committee on atomic weights. His *Data of geochemistry*, published in five editions by the Geological Survey, is a standard reference work. He was a member of the National Academy of Sciences, the Philosophical Society of Washington, and of many other scientific organizations, and an honorary member of the Chemical Society of London, the Mineralogical Society of London, the Russian Mineralogical Society, and the Manchester Literary and Philosophical Society. In 1900 he was made Chevalier of the Légion d'Honneur. He was president of the American Chemical Society in 1901 and of the Cosmos Club during 1917. As an honorary curator of minerals in the National Museum he did much to bring the collections to their present excellence. It was largely through his effort that this JOURNAL was founded in 1911.

WILLIAM JASPER SPILLMAN, agricultural economist of the Department of Agriculture, died in Washington July 11, 1931. He was born in Lawrence County, Mo., Oct. 23, 1863, and studied at the University of Missouri, from which he received the degrees of bachelor of science (1886), master of science (1889), and doctor of science (1910). He was professor of science at the Missouri State Normal School (1887–89), Vincennes University (1889–91), and Oregon State Normal School (1891-94), and professor of agriculture at Washington College (1894-1901). He became an agrostologist in the U. S. Department of Agriculture in 1902, and from 1905 to 1918 was agriculturist in charge of farm management investigations. Among Dr. Spillman's best-known publications are *Farm grasses of the United States*, *Farm science*, and *Balancing of the farm output*.